Technical Documentation for the Census Bureau Index of Economic Activity

The Census Bureau Index of Economic Activity (hereafter "the index") is a compilation of 15 of the Census Bureau's primary monthly economic time series intended to provide, to the extent possible, a single time series reflecting the variation over time in the whole set of component series. Thus, the index is designed to provide an "at-a-glance" snapshot of the combined movement of these different series. The component series, which are listed in the following table, provide monthly estimates reflecting economic activity in the sectors of retail and wholesale trade, manufacturing, residential construction, and international trade, as well as in monthly estimates of business formations.

Data Series Included in Index

Series	Source
Business Applications	Business Formation Statistics
Exports of Goods and Services	International Trade: Goods & Services
Housing Units Authorized in Permit-Issuing Places	New Residential Construction
Housing Units Completed	New Residential Construction
Housing Units Started	New Residential Construction
Imports of Goods and Services	International Trade: Goods & Services
Manufacturing Inventories	Manufacturers' Goods
Manufacturing Value of New Orders	Manufacturers' Goods
New Orders for Durable Goods	Advance Report Durable Goods
New Single-Family Houses for Sale	New Residential Sales
New Single-Family Houses Sold	New Residential Sales
Retail Inventories	Advance Economic Indicator Report
Retail Trade and Food Services Sales	Advance Monthly Retail Trade
Total Construction Spending	Construction Spending
Wholesale Trade Inventories	Advance Economic Indicator Report

The index is constructed by applying the method of principal components analysis (PCA) to the time series of monthly growth rates of the seasonally adjusted component series. The monthly growth rates are month-to-month percentage changes standardized to have mean zero and variance 1. Similar PCA approaches have been used for the construction of other economic indices, including the Chicago Fed National Activity Index, which is issued by the Federal Reserve Bank of Chicago, and the Weekly Economic Index, which is issued by the Federal Reserve Bank of New York.[1] The index from the PCA approach is a linear combination of the component series with weights determined to maximize the variation over time (subject to a scaling constraint on the weights). The growth rates of the inputs are standardized to put the component series on a comparable scale to prevent components whose growth rates inherently fluctuate the most from dominating the contributions to the index.

The index weights are determined by applying PCA to the 15 standardized growth rate series over the

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[1] More detailed background information about the Chicago Fed National Activity Index (CFNAI) can be found at www.chicagofed.org/cfnai, and more information about the Weekly Economic Index (WEI) can be found at https://www.newyorkfed.org/research/policy/weekly-economic-index#/.

period August 2004 to February 2020, using the weights for the first principal component to construct the index. The starting date of August 2004 was the earliest month for which all the input series growth rates were available.[2] The PCA weight calculations omit data from March 2020 onward to avoid potential distortions due to the COVID-19 pandemic. The resulting weights are then applied to the input data from August 2004 to the present time to calculate the index beyond February 2020. Comparisons done of alternative versions of the index obtained using index weights calculated from alternative time frames of the data produced similar results. In particular, all of the alternatives reflected the largest movements in the Great Recession period and the COVID-19 pandemic.

The index is a monthly index since it is constructed from time series of estimated monthly growth rates. However, the index is calculated and published each business day from the latest values of the components drawn from the Census Bureau's Application Programming Interface (API).[3] The index is thus updated whenever a new estimate is released for any of its component series. Since release dates for the component series vary through the month, with slight variations in the time of month that any one component series is released, updates to the index are frequent. It is the case that, at most points in time, some of the component series provide estimates that are more recent than the others by one month. To address this situation, component series that are one month behind are predicted (nowcast) for the current index month, using a multivariate autoregressive time series model.

Statistical uncertainty measures are not currently available for the index. The input time series for the index are subject to various errors, and these errors will indeed produce errors in current and historical values of the index, with the contributions of errors from the various inputs influenced by their index weights obtained from PCA. Likewise, nowcasting in the most recent month adds error. All the input series are subject to various nonsampling errors, some of which are reflected in revisions made to their historical estimates, particularly for recent months. Some of the input series derive from Census Bureau sample surveys, and these series are subject to sampling error. Other input series, such as exports and imports, derive from essentially complete data tabulations rather than a sample, and so are not subject to sampling errors. Information about the input series, including information available about their sampling and nonsampling errors, can be found at the links for the series given in the table. Future research will investigate the possibilities for quantifying error in the index and providing uncertainty measures.

Technical details about construction of the index, and some related analyses, will be provided in a technical report under development. Links to the technical report will be provided when it is available.

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[2] The latest starting date for any of the level series was for Business Applications, which started in July 2004. This then yielded growth rates starting in August 2004.
[3] More information on the Census Bureau's API is available at https://www.census.gov/data/developers/data-sets/economic-indicators.html.

The Census Bureau has reviewed the public domain products for unauthorized disclosure of confidential information and has approved the disclosure avoidance practices applied to this release.

Source: U.S. Census Bureau
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